



IND Cubesat Briefing/Technical Exchange

10 November 2015



DSN Interfaces
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Agenda

- **Introduction**
- **Service Interfaces**
 - **Command**
 - **Telemetry**
 - **Tracking**
 - **Monitor**
 - **Service Preparation**

Introduction

- All interfaces are documented on the DSN Interface Server jaguar
 - <https://jaguar.jpl.nasa.gov/>
 - All are modules in document 820-013
 - Access is controlled; MIM can arrange for access
- Many of the interfaces are based on CCSDS standards
 - Assumes that spacecraft follow CCSDS standards for frames, packets, and encoding (CCSDS 732.0-B-3, 133.0-B-1, and 131.0-B-2, respectively), among others
- In the next 2 years, a modular document, 810-007, will be populated with modules describing the various DSN services
 - Similar in structure to 810-005
 - Available at <http://deepspace.jpl.nasa.gov/dsndocs/810-007/>
- Standard versus non-standard interfaces:
 - In some cases, there are standard and non-standard interfaces
 - Standard interfaces are the IND recommended interfaces for that service
 - Non-standard interfaces are interfaces that provide the service data in different formats from the standard interfaces and can be made available if the standard interfaces do not meet the mission's needs

Command

- **Standard**
 - **Command Link Transfer Unit (CLTU)**
 - **CCSDS 912.1-B-3 (2010 Blue Book)**
 - **Documented in 820-013 0239-Telecomm**
 - **File**
 - **Files transferred to the spacecraft via CCSDS File Delivery Protocol (CFDP; CCSDS 727.0-B-4)**
 - **Documented in 820 0213-Telecomm-CFDP**
- **Non-standard**
 - **Spacecraft Command Message File (SCMF)**
 - **File of CLTUs formatted in the CCSDS Standard Formatted Data Unit (SFDU; CCSDS 620.0-B-2) format**
 - **Documented in 820-013 0191-Telecomm**
 - **Radiation can be controlled in real time or queued for later release**
 - **Web interface capability documented in 820-013 0231-Telecomm-CMD**
 - **Format of the queued radiation list is in 820-013 0217-Telecomm-CMD**

Telemetry (1 of 2)

- **Standard**
 - **Frame**
 - **Successfully decoded telemetry frames via the CCSDS Space Link Extension (SLE)**
 - Return All Frames (RAF) – CCSDS 911.1-B-3 (2010 Blue Book)
 - Return Channel Frames (RCF) – CCSDS 911.2-B-2 (2010 Blue Book)
 - Timely, complete, and off-line modes supported
 - **Currently documented in 820-013 0163-Telecomm; future module is 820-013 0243-Telecomm**
 - **File**
 - **Files transferred from the spacecraft via CCSDS File Delivery Protocol (CFDP; CCSDS 727.0-B-4)**
 - **Documented in 820 0213-Telecomm-CFDP**
 - **Delivery method documented in 0240-Telecomm-TTCFS-Data**
 - **Beacon**
 - **Spacecraft sends one of four tones to indicate status**
 - **Used for quick spacecraft health checks during cruise**
 - **Tone number available as SLE-like interface**
 - **Documented in 820-013 0233-Telecomm**

Telemetry (2 of 2)

- **Non-standard**
 - **Frame**
 - Frames delivered in SFDUs
 - Documented in 820-013 0172-Telecomm
 - Delivery method documented in 820-013 0234-Telecomm-TLMWEB
 - **Packet**
 - Packets extracted from frames, delivered in SFDUs
 - Documented in 820-013 0172-Telecomm
 - Delivery method documented in 820-013 0234-Telecomm-TLMWEB
 - **File**
 - A file of frames (formatted as SFDUs)
 - Delivery method documented in 820-013 0223-Comm-WEB

Tracking

- **There are three main tracking data types provided by the DSN:**
 - **Doppler**
 - **Ranging**
 - **Delta-DOR**
 - **Requires scheduling 2 sites when both can see the spacecraft**
- **There are two formats for the data to be delivered:**
 - **Tracking Data Message (TDM), which is based on the CCSDS TDM (TDM CCSDS 503.0-B-1) and is documented in 820-013 0212-Tracking-TDM**
 - **Tracking System Data Archival Format, whose format is an SFDU and is documented in 820-013 TRK-2-34**
- **Only the TRK-2-34 data format is available as a real time data stream**
- **Both data formats are available for file delivery, normally post-pass**

Monitor

- **Monitor data for the DSN link performance is provided on 5 second intervals**
 - **Includes such items as link SNRs, antenna pointing information, uplink / downlink frequencies, etc.**
- **Delivery is real time and not guaranteed**
- **Delivered via UDP**
- **Data format is in SFDUs**
 - **Format is documented in 820-13 0158-Monitor**

Service Preparation (1 of 3)

- **Service preparation interfaces provide the DSN with the needed information to prepare the network for the tracking activity**
 - **Spacecraft trajectory**
 - **Tracking schedule request**
 - **Spacecraft pass configuration and sequence of events (SOE)**

Service Preparation (2 of 3)

- **Spacecraft trajectory**
 - In general, two grades of spacecraft trajectory information is needed
 - Less accurate, long span for computing view periods for scheduling the tracks
 - More accurate, shorter span for computing the antenna pointing and frequency predictions for a pass
 - The recommended interface is based on the CCSDS Orbit Ephemeris Message standard (CCSDS 502.0-B-1) and is documented in 820-013 0194-Navigation-OEM
 - Also supported is the Spacecraft-Planet Kernel (SPK) format, documented in 820-013 TRK-2-33
 - The interface for submitting the data is documented in 820-013 0168-ServiceMgmt
- **Tracking schedule request**
 - The schedule request is input by the scheduler via the Service Scheduling Software (SSS)
 - The formats for the schedule request input and the output schedule are documented in 820-013 OPS-6-12 (revision G is the current version)

Service Preparation (3 of 3)

- **Spacecraft configuration / Sequence of Events**
 - To track the spacecraft, the DSN needs to know the spacecraft configuration (e.g., data rates, uplink tuning times, etc.)
 - Depending on how the spacecraft will be operated, this input can be handled in two ways
 - If the spacecraft will have a fixed set of configurations and events that are not dynamic, then the DSN will develop, with the mission's input, a set of Nominal SOEs (NSOE) that will be used during the mission
 - As part of the scheduling process, the mission selects which NSOE will be used for each track
 - If the spacecraft is more dynamic, then the mission needs to input the SOE using the DSN Keyword File (DKF) interface (820 OPS-6-13) for each pass
 - Submission is via the 820-013 0168-ServiceMgmt interface
 - Note that an eventual replacement for the DKF, 820-013 0211-ServiceMgmt-SEQ is being implemented, but is not yet available for use